

SECTION 13 TIMBER STRUCTURE

13.1 INTRODUCTION TO RATING TIMBER BRIDGES RATINGS

This section covers the rating of timber stringers and decks. All timber members will be rated using the policies and guidelines in Section 1.

All timber stringers shall be rated using the AASHTOWare Bridge Rating program BrR. The timber decks shall be rated with CDOT Timber Bridge Rating program that is available from the Staff Bridge Branch Software Library.

All other types of timber stringers and decks will be rated in compliance with the applicable guidelines within this manual and the AASHTO codes.

Examples are presented for the three-stringer types listed below, as well as transverse nail laminated timber decks, and transverse plank timber decks.

Timber structures are repaired with the sister beam method using guidelines in Subsection 13.8.

For rating non-timber decks, see Section 3.

An important aspect of rating timber bridges is that the rating should reflect the actual condition of the members, as reported from field inspections. The guidelines for evaluating and accounting for the condition of timber members are shown in Subsection 13-3.

The types of stringers covered by this section are:

- TS - Timber Stringer - Timber Deck
- TTD - Treated Timber Stringer - Concrete Deck
- TTS - Treated Timber Stringer - Timber Deck

13.2 POLICIES AND GUIDELINES FOR RATING TIMBER STRINGERS

13.2.1 General

- A) Allowable stress method shall be used to rate timber structures.
- B) Timber stringers shall be rated using the BrR program. Nail laminated and plank decks shall be rated using the TIMBER computer program as mentioned in Subsection 13.6.
- C) When plans are not available, timber stringers may be rated with BrR software using field dimension in accordance Section 1.7.1.

- D) When plans are not available, the allowable stress values in Section 1.5 Table 1-3 for Douglas Fir-Larch Select Structural can be used.
- E) The allowable stress value for shear may be increased by a modification factor of 1.33. This factor will always be used for stringers without splits and in good condition. If a beam or stringer is split horizontally, the increase factor is not allowed; see Subsection 13.3.
- F) Adjustment factors for timber deck and stringer may be defaulted by using the BrR compute button.
- G) For structures constructed after year 1960, the allowable stresses shall be modified according to the AASHTO STANDARD SPECIFICATIONS FOR HIGHWAY BRIDGES.
- H) For existing timber bridges, CDOT used lumber that has not been dressed / surfaced. The stringers may be considered as the full-sawn lumber sizes. The stringer sizes as presented in the design plans, or CARDEX may be used for ratings rather than dry dimensions, except the actual dimensions are verified by the inspectors.
Commentary: The full-sawn lumber is the same size as the stated nominal size. (Timber Bridges Design, page 3-40, Construction, Inspection, and Maintenance, 1990 – Michael A. Ritter, United States Department of Agriculture, Forest Service).
- I) The rater shall evaluate and account for the condition of timber members as specified in Subsection 13.3.

13.2.2 Stringers Requiring Rating

- A) Interior Stringers - A rating is required for the critically loaded interior stringer combined with the worst condition. Factors that influence condition are splits, broken, and repaired stringers, and wood condition. More than one interior stringer may require an analysis due to variation in span length, stringer size, stringer spacing, differences in loads or moments, etc.
- B) Exterior Stringers - An exterior stringer shall be rated when the section used is different than the section used for an interior stringer.

13.2.3 Dead Loads

- A) When rating timber bridges with timber decks use the maximum asphalt thickness obtained along a transverse cross section taken at midspan, rather than the average thickness, for dead load calculations.
- B) For timber or metal plank decks, dead loads due to railing curbs, and wheel guards shall not be distributed to all stringers, but shall be considered to be carried by the exterior stringer.
- C) The method of applying dead loads due to utilities is left to the rater's discretion.

13.2.4 Rating Reporting / Package Requirements

The rater and checker shall complete the rating documentation as described in Section 1 of this manual. Any variation from the original design assumptions shall be added to the Rating Summary Sheet as applicable. The rating package requirements shall be per Section 1.13 of this manual and as amended herein:

Consultant designed projects – Before finalizing the rating package and when BrR is used as the analysis tool, the Rater shall verify with the Staff Bridge Rating Coordinator that the version number of the program being used is identical to CDOT'S version number. Data files created using a lower, or higher version of the program shall be rejected, except if approved in advance by the Bridge Rating Engineer. It is required for the CDOT data archive, since the data base management feature inside the program would not work satisfactorily. After the analysis is completed, the rater shall save the data file. When saving is finalized, the rater shall export the data file in *.xml format (i.e., O-18-BY.xml format).

13.3 EVALUATING CONDITION OF TIMBER MEMBERS

13.3.1 Broken Stringers

- A) In a broken stringer the wood is completely separated. The separation must extend a distance equal to or greater than one-fourth the depth of the stringer.
- B) For a broken stringer, the rater shall assume that the stringer is not there. Use stringer spacing equal to 1.5 times the actual spacing for dead load and live load distribution calculations.

13.3.2 Cracked Stringers

- A) A cracked stringer is similar to a broken stringer. A cracked stringer must be separated completely through the stringer in a lateral or transverse direction (at or nearly at 90 degrees to the longitudinal axis of the stringer); however, the separation must not extend vertically into the stringer more than one-fourth the depth of the stringer.
- B) The rater will evaluate the crack as follows, depending upon its location in the stringer:
 - 1. In the 1/4 span closest to the support the rater shall use the allowable shear stress values given in AASHTO without the shear increase factor from subsection 13.2.
 - 2. In the center-half of the span, the rater shall calculate the effective or reduced section depth, corresponding to the crack location on the beam, in order for the TIMBER computer program to determine the bending moment capacity.

13.3.3 Split Stringers

- A) To be a split, it must penetrate completely through the stringer and may or may not extend the full length of the stringer.
- B) A split will not reduce a member's bending capacity.

- C) For stringers that are split the allowable shear stress values given in AASHTO shall be used without the shear increase factor from Subsection 13-2.

I **13.3.4 Checked Stringers**

- A) A check is a separation of the wood along the fiber direction resulting from stresses set up in wood during seasoning, and usually extends across the rings of annual growth.
- B) Checks in a stringer may be on either or both sides.
- C) A check will not be considered to reduce the load carrying capacity of a timber member.

I **13.3.5 Shaked Stringers**

- A) A shake is the result of the growth in the tree and may easily be mistaken as a check.
- B) A shake will not be considered to reduce the load carrying capacity of a timber member.

I **13.3.6 Decay**

- A) Decay can reduce a member's load capacity.
- B) A reduced section will be rated for shear or bending strength depending on the location.

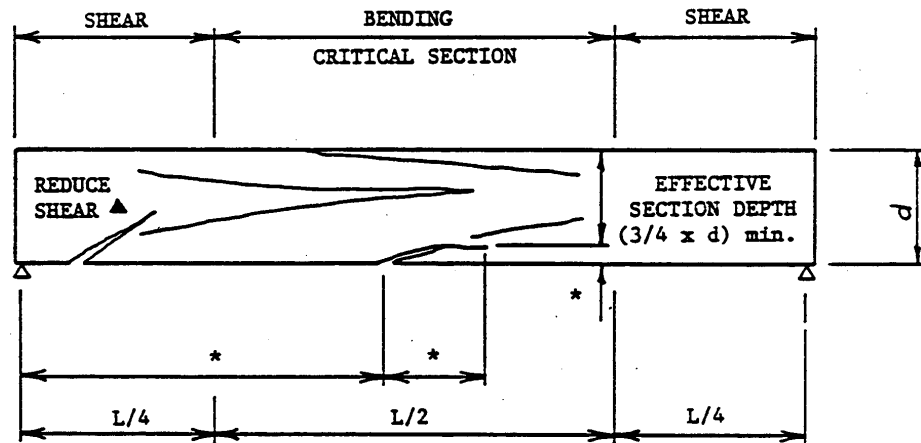
I **13.3.7 Aging**

- A) No adjustment in the allowable stresses for timber is necessary for reasons of aging alone. This is in accordance with ASTM D 245, April 10, 2000.

EVALUATING CONDITION OF TIMBER MEMBERS

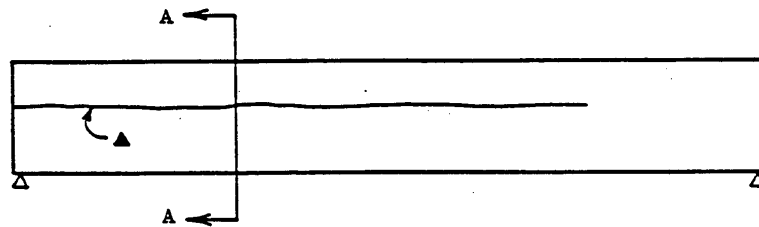


BROKEN STRINGER



* REQUIRES DIMENSION

CRACKED STRINGER

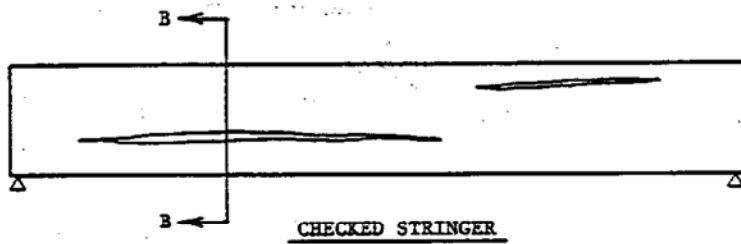


SECTION AA

SPLIT STRINGER

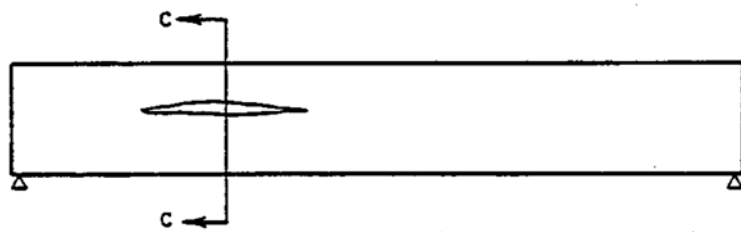
▲ Use allowable shear value (F_v) without 1.33 increase in these areas.

EVALUATING CONDITION OF TIMBER MEMBERS



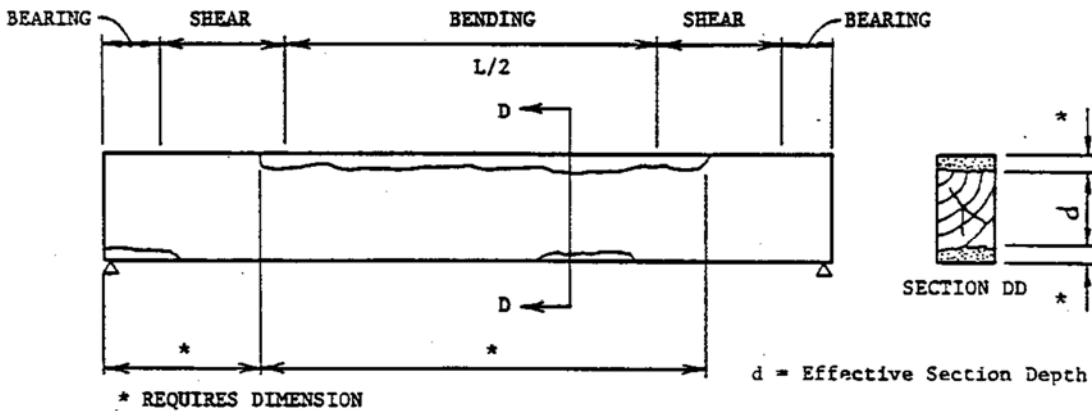
CHECKED STRINGER

SECTION BB



SHAKED STRINGER

SECTION CC



* REQUIRES DIMENSION

d = Effective Section Depth

DECAYED STRINGER

13.4 GUIDELINES FOR USING THE BrR RATING PROGRAM

The BrR computer program performs the analysis and rating of simple span timber bridges. BrR uses the Madero ASD analysis engine. This program was developed in accordance with the AASHTO STANDARD SPECIFICATIONS and the AASHTO MANUAL FOR CONDITION EVALUATION OF BRIDGES.

The program will not rate sawn timber decks, glue laminated stringers, glue laminated flooring, flooring placed longitudinally, splined or doweled flooring, multiple layered decks, nor nontimber decks. For required modification to the allowable stresses, see Subsection 13.2 and 13.3.

The library explorer can be used to save commonly used items (beam shapes, non standard vehicles, materials, appurtenances etc.) and this eliminates the need for all users to define the same items repeatedly throughout the program. Once a new girder shape is defined or copied from the library, BrR automatically computes the required section properties and beam constants.

The program does consider uniform dead loads other than those caused by the stringers, deck, and overlay. In the case where other dead loads are present that would substantially affect the rating, they shall be accounted for during the analysis.

In the Live Load Distribution Factor window, when the compute button is used to calculate the DF's automatically by the program, BrR users shall verify that these numbers are accurate and matches their calculated numbers.

Timber structures should rate using ASD for three stringer conditions (**no split stringer, split stringer, and repaired split stringer**) based on updated section 1 in CDOT BRM, as shown below:

- A) For no split stringer (more than 75% of the total number of stringers have NO splits or shear cracks) should use inventory bending stress 1600 psi and 113 psi for inventory parallel shear stress.
- B) For split stringers (more than 25% of the total number of the stringers are not repaired or have shear cracks) should use inventory bending stress 1600 psi and inventory parallel shear stress 85.0 psi.
- C) For repaired split stringer by lag bolts (more than 25% of the total number of stringers are repaired) should use inventory bending stress 1600 psi and 98 psi for inventory parallel shear stress.

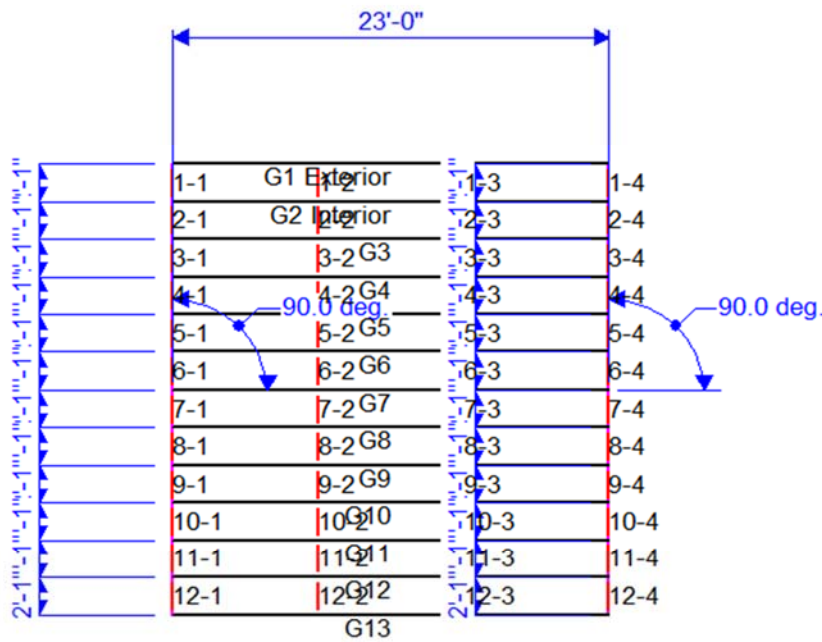
In rating summary sheet rater should report all interior stringer capacity for three above condition, with referring for current stringer condition split/no split or repaired.

One example is presented for structure A-27-A, a two span bridge having treated timber stringers with timber decks. For simplicity, only one span has been modeled using the above conditions of the members as reported in the field inspection report.

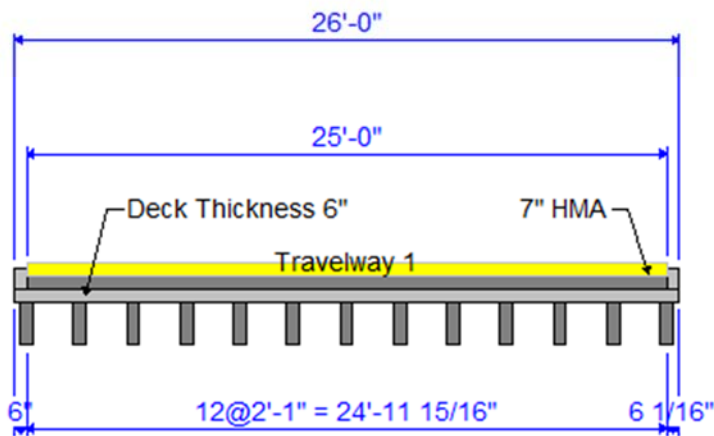
13.5 BRIDGE RATING EXAMPLE

TIMBER STRUCTURE EXAMPLE, STRUCTURE NO. A-27-A

A-27-A
 -1 - No split Structure Definition # 1
 US 385 ML / DRAW
 06/24/19



A-27-A
 -1 - No split Structure Definition # 1
 US 385 ML / DRAW
 06/24/19

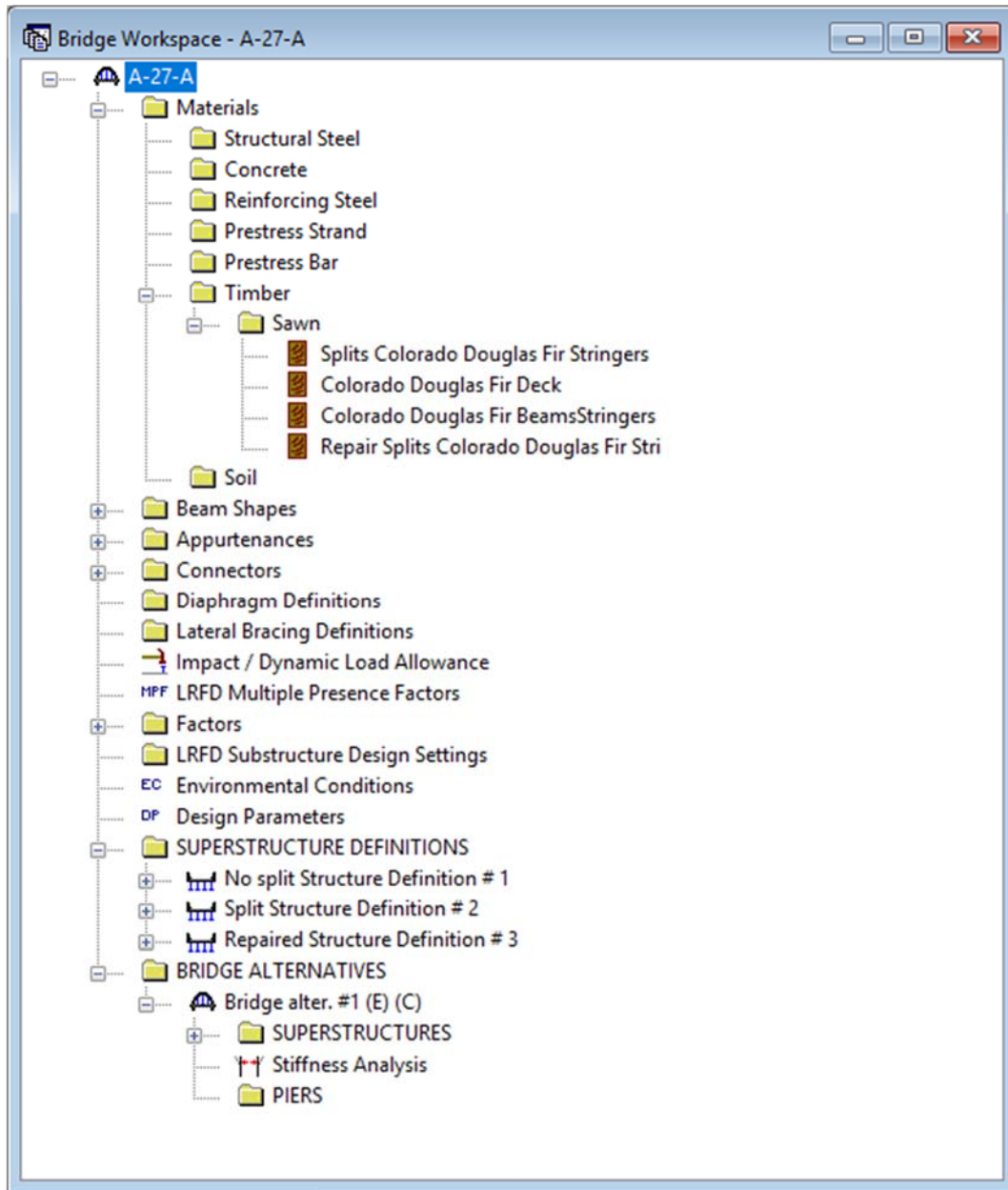


From the bridge explorer, create a new bridge and enter the following information.

The screenshot shows a software window titled "A-27-A" with a standard Windows-style title bar (minimize, maximize, close). The window contains a form for entering bridge data. At the top, there are two text boxes: "Bridge ID:" with the value "A-27-A" and "NBI Structure ID (8):" with the value "A-27-A". To the right of these are two checkboxes: "Template" (unchecked) and "Superstructures" (checked). Below these are two more checkboxes: "Bridge Completely Defined" (unchecked) and "Culverts" (unchecked). A tabbed interface is visible, with the "Description" tab selected. The "Description" tab contains a large text area with the following text: "Initial rating was implemented in Virtis/Opis by H.K. in 3/2003. Re-rated in virtis for system definition, J.W.G 12/2005 aip 5/06 Re-rated by AI for split/ repair more than 25%". Other fields include "Name:" with the value "-1", "Year Built:" with the value "1949", "Location:" with the value "18 MI S OF JULESBURG/I", "Length:" with the value "48.00" and "ft", "Facility Carried (7):" with the value "US 385 ML", "Route Number:" with the value "0385D", "Feat. Intersected (6):" with the value "DRAW", and "Mi. Post:" with the value "291.48". At the bottom left, there is a button labeled "AASHTOWare Association...". To its right are three checkboxes: "BrR" (checked), "BrD" (checked), and "BrM" (unchecked). At the bottom right, there are three buttons: "OK", "Apply", and "Cancel".

Click OK. This saves the data to memory and closes the window.

To add three a new timber material, click on Materials, Timber, and Sawn in the tree and select File/New from the menu (or right click on Sawn and select New). Click the Copy from Library button and select the Colorado Douglas Fir Beams Stringers from the library. Click OK and the following window will open. The ASD Tabulated Design Values in this window are based on dry conditions and do not include any adjustment factors based on usage conditions. Make necessary corrections to the allowable bending and shear stress values for No Split, Split and Repaired conditions. Click OK to save these timber materials to memory and close the window.



For No split stringer condition materials properties

Bridge Materials - Timber - Sawn

Name: Colorado Douglas Fir BeamsStringers Description: No Splits, Commercial Grade

Grading method: Visual

Species: Douglas Fir-Larch

Commercial grade: Select Structural

Size classification: Beams and Stringers

Grading rules agency: Unknown

Density: 0.05 kcf

Modulus of elasticity: 1600.00 ksi

ASD Tabulated Design Values

Bending:	1.600	ksi
Tension (parallel):	0.950	ksi
Shear (parallel):	0.113	ksi
Compr. (perp.):	0.625	ksi
Compr. (parallel):	1.100	ksi

Copy To Library... Copy from Library... OK Apply Cancel

For split stringer condition materials properties

The screenshot shows a software dialog box titled "Bridge Materials - Timber - Sawn". The dialog contains several input fields and a table of design values.

Name: **Description:**

Grading method: **Species:**

Commercial grade: **Size classification:**

Grading rules agency:

Density: kcf **Modulus of elasticity:** ksi

ASD Tabulated Design Values

Bending:	<input type="text" value="1.600"/>	ksi
Tension (parallel):	<input type="text" value="0.950"/>	ksi
Shear (parallel):	<input type="text" value="0.085"/>	ksi
Compr. (perp.):	<input type="text" value="0.625"/>	ksi
Compr. (parallel):	<input type="text" value="1.100"/>	ksi

Buttons at the bottom:

For repaired split stringer condition materials properties

Bridge Materials - Timber - Sawn

Name: Fair Splits Colorado Douglas Fir Str Description: Repaired, Commercial Grade

Grading method: Visual

Species: Douglas Fir-Larch

Commercial grade: Select Structural

Size classification: Beams and Stringers

Grading rules agency: Unknown

Density: 0.05 kcf

Modulus of elasticity: 1600.00 ksi

ASD Tabulated Design Values

Bending: 1.600 ksi

Tension (parallel): 0.950 ksi

Shear (parallel): 0.098 ksi

Compr. (perp.): 0.625 ksi

Compr. (parallel): 1.100 ksi

Copy To Library... Copy from Library... OK Apply Cancel

Inventory shear stress for repaired split stringer = $*130 / 1.33 = 98$ psi
(* see Section 1, Table 1-3)

Follow the same procedure to copy from the Materials library. Change the name of material and size classification. Click OK to save this timber deck material to memory and close the window.

Bridge Materials - Timber - Sawn

Name: Description:

Grading method:

Species:

Commercial grade:

Size classification:

Grading rules agency:

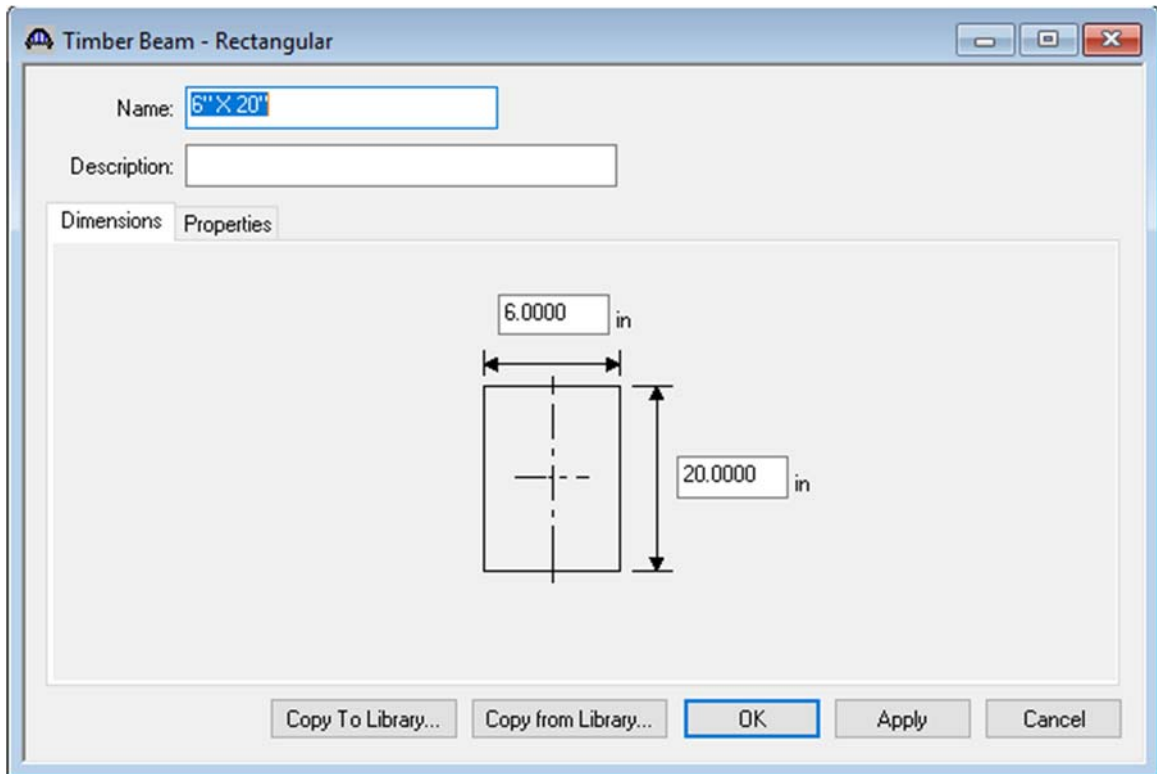
Density: kcf

Modulus of elasticity: ksi

ASD Tabulated Design Values

Bending:	<input type="text" value="1.600"/>	ksi
Tension (parallel):	<input type="text" value="0.950"/>	ksi
Shear (parallel):	<input type="text" value="0.113"/>	ksi
Compr. (perp.):	<input type="text" value="0.625"/>	ksi
Compr. (parallel):	<input type="text" value="1.100"/>	ksi

Add a new timber beam shape by clicking on Beam Shapes, Timber, and Rectangular in the tree and selecting File/New from the menu (or double clicking on Rectangular). Enter the final beam dimensions to be used to calculate section properties on the dimensions tab. Dressed dimensions shall not be used. Click OK to save the data to memory and close the window.



Click the Properties tab, and then Compute. Click OK to save the data to memory and close the window.

The screenshot shows a software dialog box titled "Timber Beam - Rectangular". It has a "Name" field containing "6" X 20\"", a "Description" field, and two tabs: "Dimensions" and "Properties". The "Properties" tab is active, displaying several input fields with numerical values and units:

Property	Value	Unit
Area	120.00	in ²
Nominal load		lb/ft
Moment of inertia	4000.0	in ⁴
CG from bottom	10.0000	in
Section modulus, top	400.0	in ³
Section modulus, bottom	400.0	in ³
Nominal width	6.00	in
Nominal depth	21.0000	in

At the bottom of the dialog, there are buttons for "Copy To Library...", "Copy from Library...", "OK", "Apply", and "Cancel". A "Compute" button is also present in the bottom right area of the main content.

Expand the tree labeled Appurtenances to enter the bridge appurtenances information to be used in the analysis. To define a generic railing, double click on Generic in the tree and input the generic railing dimensions. Click OK to save data to memory and close the window.

Bridge Appurtenances - Generic

Name:

Description:

All dimensions are in inches

Distance from edge to centroid =

Reference Line →

Barrier load = kip/ft

Width =

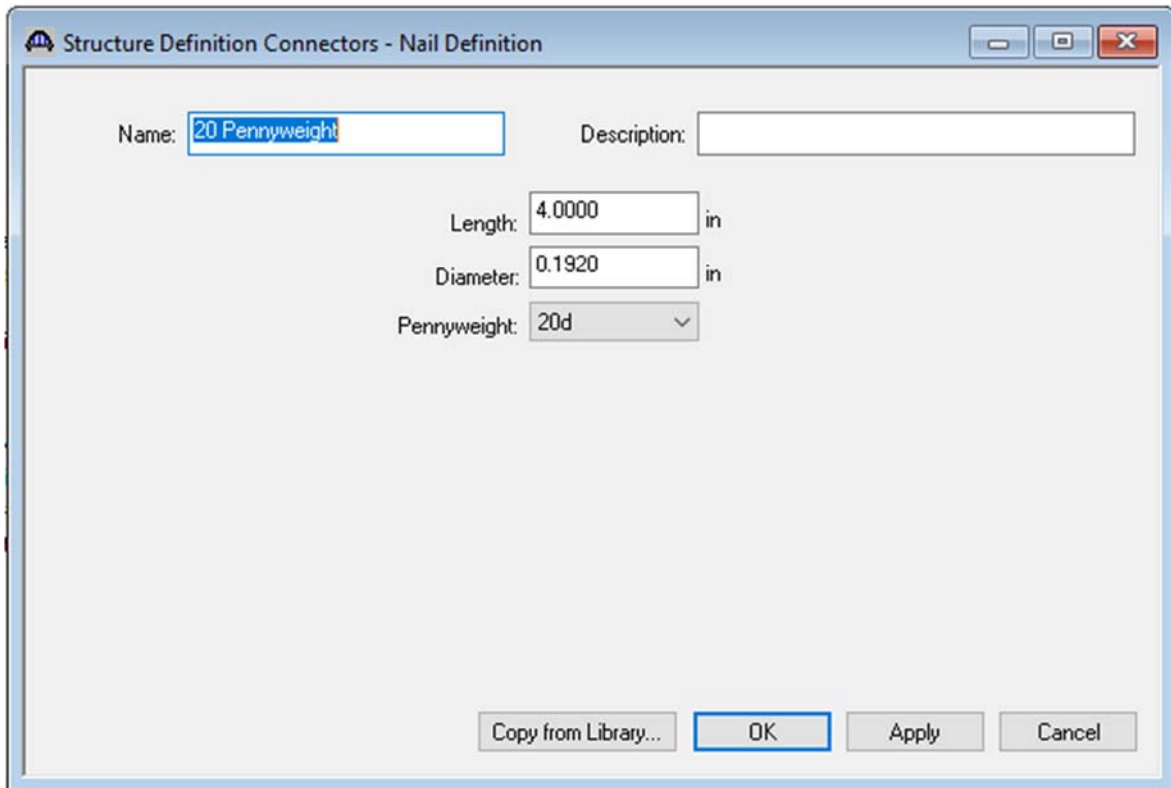
Effective wind height =

Back

Front

Generic Shape

Expand the Connectors tree item to create a nail definition. Double click on Nail. Define the nail and click OK to save to memory.

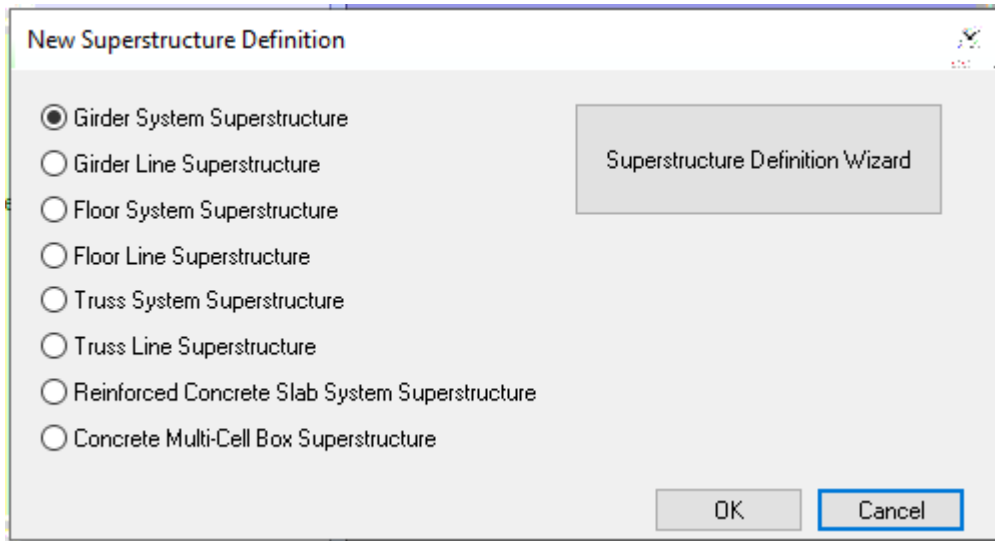


The image shows a software dialog box titled "Structure Definition Connectors - Nail Definition". It contains the following fields and controls:

- Name:** A text input field containing "20 Pennyweight".
- Description:** An empty text input field.
- Length:** A numeric input field containing "4.0000" with the unit "in" to its right.
- Diameter:** A numeric input field containing "0.1920" with the unit "in" to its right.
- Pennyweight:** A dropdown menu currently showing "20d".
- Buttons:** At the bottom, there are four buttons: "Copy from Library...", "OK", "Apply", and "Cancel". The "OK" button is highlighted with a blue border.

Now that we have created a nail definition, this can be applied to nails in the deck. Reopen the Structure Typical Section: Deck (cont'd) tab. Select the 20 Pennyweight nail definition as the nail on that tab. Click OK to save to memory and close the window.

Double click on STRUCTURE DEFINITION (or click on STRUCTURE DEFINITION and select File/New from the menu or right mouse click on STRUCTURE DEFINITION and select New from the popup menu) to create a new structure definition. The following dialog box will appear.



Select Girder System and the following Structure Definition window will open. Enter the appropriate data as shown below.

Girder System Superstructure Definition

Definition Analysis Specs Engine

Name: No split Structure Definition # 1

Description:

Default Units: US Customary

Number of spans: 1

Number of girders: 13

Enter Span Lengths Along the Reference Line:

Span	Length (ft)
1	23.00

Frame Structure Simplified Definition:

Deck type: Timber

For PS only

Average humidity: %

Member Alt. Types

Steel

P/S

R/C

Timber

Horizontal Curvature Along Reference Line

Horizontal curvature

Superstructure Alignment

Curved

Tangent, curved, tangent

Tangent, curved

Curved, tangent

Distance from PC to first support line: ft

Start tangent length: ft

Radius: ft

Direction: Left

End tangent length: ft

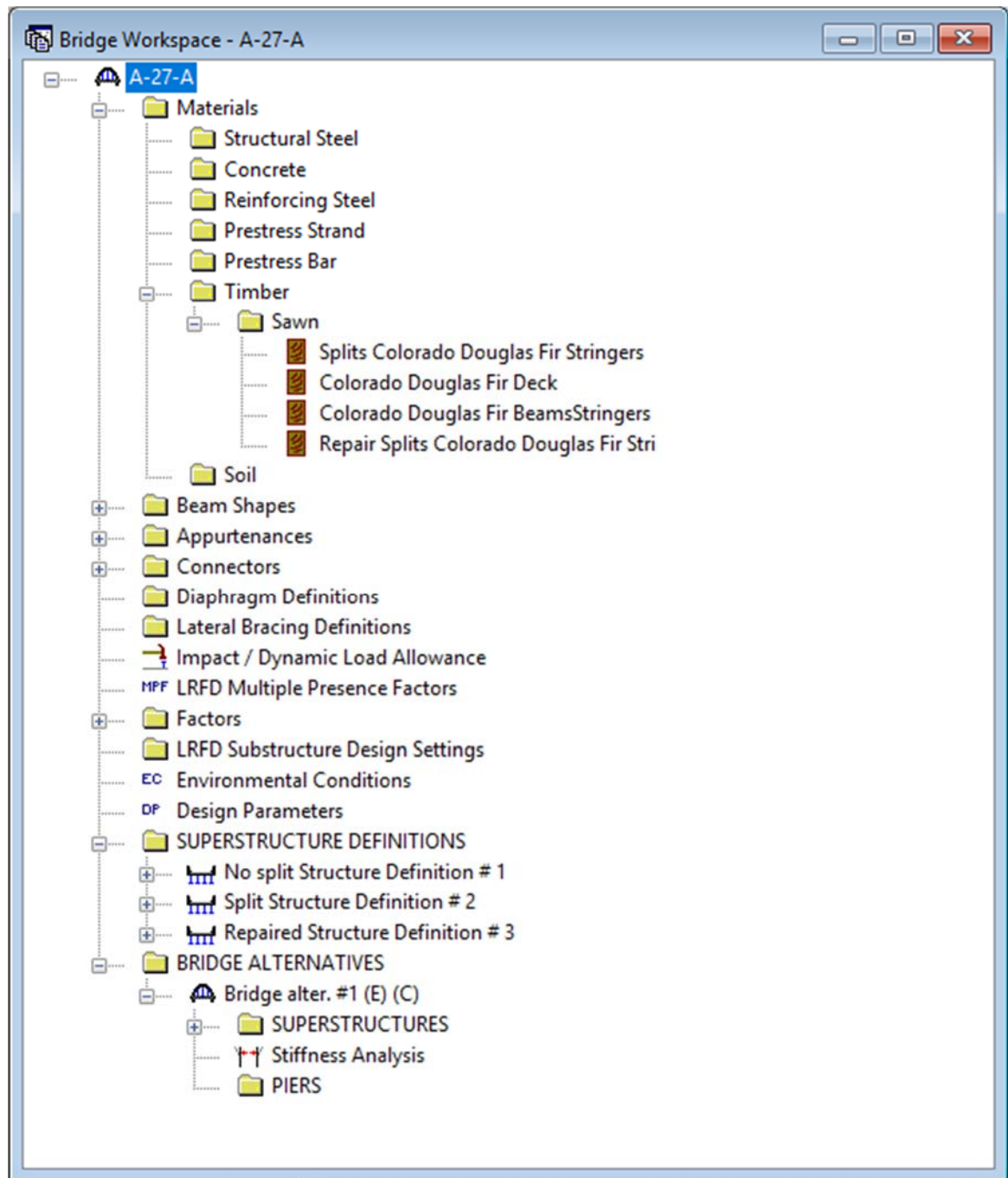
Distance from last support line to PT: ft

Design speed: mph

Superelevation: %

OK Apply Cancel

Following is the partially expanded Bridge Workspace tree:



Click Load Case Description to define the dead load cases. The load types are presented in a single row separated by a comma. The first type applies to LFD design and the second type applies to LRFD design and it corresponds with the load types presented in the AASHTO Specifications. The completed Load Case Description window is shown below.

Load Case Name	Description	Stage	Type	Time* (Days)
HMA		Non-composite (Stage 1)	D,DW	
Rail		Non-composite (Stage 1)	D,DC	

*Prestressed members only

Add Default Load Case Descriptions

New Duplicate Delete

OK Apply Cancel

Double click on Framing Plan Detail to describe the framing plan. Enter the appropriate data to describe the framing plan. If the bridge has diaphragms, switch to the Diaphragms tab and enter the appropriate data. Click OK to save to memory and close the window.

Structure Framing Plan Details

Number of spans = 1 Number of girders = 13

Layout Diaphragms

Girder Spacing Orientation

Perpendicular to girder

Along support

Support	Skew (Degrees)
1	0.0000
2	0.0000

Girder Bay	Girder Spacing (ft)	
	Start of Girder	End of Girder
1	2.08	2.08
2	2.08	2.08
3	2.08	2.08
4	2.08	2.08
5	2.08	2.08
6	2.08	2.08
7	2.08	2.08
8	2.08	2.08
9	2.08	2.08
10	2.08	2.08
11	2.08	2.08
12	2.08	2.08

OK Apply Cancel

The Deck tab is used to enter information about the deck. BrR only supports transverse timber decks. Select the type of deck as Nail-Laminated. The timber material to be used for the deck is selected from the list of bridge materials described above. A Nail definition has not been created yet, so leave the field blank for now. The Deck LL distribution width in the direction normal to the flooring span shall be per AASHTO Standard Specifications, Article 3.25.1.1. For this structure, this value is equal to 21.0 inches (15 inches plus thickness of floor).

Deck

Description Factors Engine

Default rating method: ASD

Analysis Module
ASD: Madero ASD

Deck Rating Parameters
 Deck continuous over more than 2 spans

Timber deck type: Nail-Laminated Deck

Timber material: Douglas Fir-Larch (no split)

Total deck thickness: 6.0000 in

Nominal thick.: 3.0000 in

Lamination thickness: 3.0000 in

Nominal width: 6.0000 in

Deck LL distribution width: 21.0000 in

Nail: 20 Pennyweight

OK Apply Cancel

For the Factors tab of the Deck window, factors may be defaulted by using the BrR compute button. In Colorado, dry moisture condition is used.

The screenshot shows the 'Deck' window with the 'Factors' tab selected. The window contains the following elements:

- ASD Factors:** A dropdown menu set to 'OPER' and a text input field for 'Timber' containing the value '1.33'.
- Timber Adjustment Factors:** A section containing several input fields and dropdown menus:
 - Moisture condition for shear/flexure: Dry (dropdown)
 - Moisture condition for bearing: Dry (dropdown)
 - Moisture condition for modulus: Dry (dropdown)
 - Shear factor: 1.00 (text input)
 - Flat use factor: 1.00 (text input)
 - Wet service (flexure): 1.00 (text input)
 - Repetitive use factor: 1.00 (text input)
 - Wet service (shear): 1.00 (text input)
 - Load duration factor: 1.15 (text input)
 - Wet service (bearing): 1.00 (text input)
 - Wet service (modulus): 1.00 (text input)
 - Size factor (flexure): 1.00 (text input)
- Buttons:** A 'Compute' button is located at the bottom right of the adjustment factors section. At the bottom of the window are 'OK', 'Apply', and 'Cancel' buttons.

Double click on Structure Typical Section in the Bridge Workspace tree to define the structure typical section. Input the data describing the typical section as shown below.

Structure Typical Section

Distance from left edge of deck to superstructure definition ref. line

Distance from right edge of deck to superstructure definition ref. line

Deck thickness

Superstructure Definition Reference Line

Left overhang

Right overhang

Deck Parapet Railing Generic Lane Position Striped Lanes Wearing Surface

Superstructure definition reference line is within the bridge deck.

	Start	End
Distance from left edge of deck to superstructure definition reference line =	13.00 ft	13.00 ft
Distance from right edge of deck to superstructure definition reference line =	13.00 ft	13.00 ft
Left overhang =	0.50 ft	0.50 ft
Computed right overhang =	0.50 ft	0.50 ft

OK Apply Cancel

The Generic tab is used to enter information about the appurtenances. Click New to add a row to the table. Enter the following data.

Structure Typical Section

Generic Shape

Back Front

Deck Parapet Railing **Generic** Lane Position Striped Lanes Wearing Surface

Name	Load Case	Measure To	Edge of Deck Dist. Measured From	Distance At Start (ft)	Distance At End (ft)	Front Face Orientation
Type 3 Modified Railing	Rail	Back	Right Edge	0.00	0.00	Left
Type 3 Modified Railing	Rail	Back	Left Edge	0.00	0.00	Right

New Duplicate Delete

OK Apply Cancel

Select the Lane Position tab. Enter the values shown below or click the Compute...button to automatically compute the lane positions. A dialog box showing the results of the computation opens. Click the apply button to apply the computed values.

Structure Typical Section

Deck Parapet Railing Generic Lane Position Striped Lanes Wearing Surface

Travelway Number	Distance From Left Edge of Travelway to Superstructure Definition Reference Line At Start (A) (ft)	Distance From Right Edge of Travelway to Superstructure Definition Reference Line At Start (B) (ft)	Distance From Left Edge of Travelway to Superstructure Definition Reference Line At End (A) (ft)	Distance From Right Edge of Travelway to Superstructure Definition Reference Line At End (B) (ft)
1	-12.50	12.50	-12.50	12.50

LRFD Fatigue
 Lanes available to trucks:
 Override Truck fraction:

Compute... New Duplicate Delete

OK Apply Cancel

Enter the following wearing surface information and click OK to save to memory and close the window.

Structure Typical Section

Distance from left edge of deck to superstructure definition ref. line | Distance from right edge of deck to superstructure definition ref. line

Deck thickness | Superstructure Definition Reference Line

Left overhang | Right overhang

Deck | Parapet | Railing | Generic | Lane Position | Striped Lanes | **Wearing Surface**

Wearing surface material:

Description:

Wearing surface thickness = in Thickness field measured (DW = 1.25 if checked)

Wearing surface density = pcf

Load case:

Describing a member:

The member window shows the data that was generated when the structure definition was created. No changes are required at this time. The first Member Alternative that we create will automatically be assigned as the Existing and Current Member alternative for this member.

Member name: Link with:

Description:

Existing	Current	Member Alternative Name	Description
<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	Timber Beam Interior	

Number of spans:

Span No.	Span Length (ft)
1	23.00

OK Apply Cancel

Defining a Member Alternative: Double click MEMBER ALTERNATIVES in the tree to create a new alternative. The New Member Alternative dialog will open. Select Timber for the Material Type and Rectangular Sawn Timber for the Girder Type. Only Timber is available for the Material Type since a timber deck type was selected on the Structure Definition window. Timber decks are limited to timber beams in BrR.

New Member Alternative

Material Type:

Girder Type:

OK Cancel

Enter the following data for the Member Alternative. Click OK to save to memory and close the window.

Superstructure

Superstructure Name:

Description Alternatives Vehicle Path Engine Substructures

Description:

Reference Line

Distance = ft

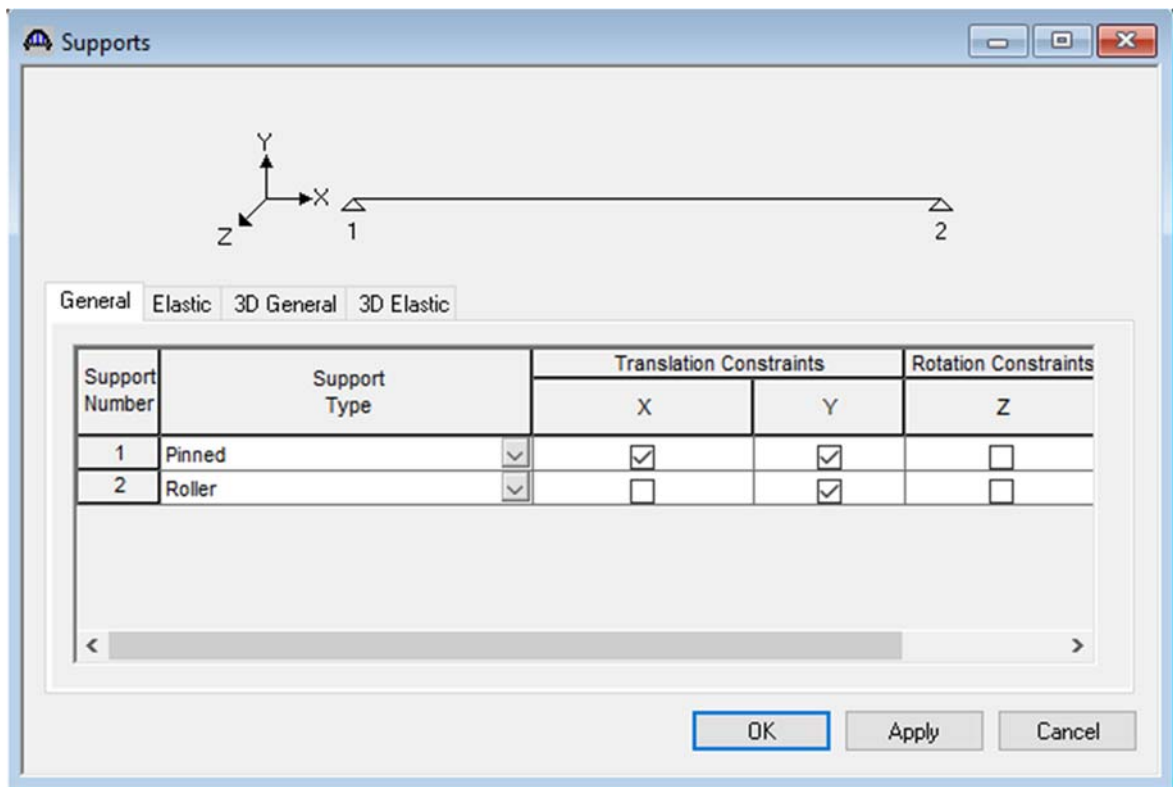
Offset = ft

Angle = Degrees

Starting Station = ft

OK Apply Cancel

Support constraints were generated when the structure definition was created and are shown below.



Use the Compute from Typical Section button to compute the live load distribution factors. Refer to AASHTO Table 3.23.1, Article 3.23.1.2 and Article 13.6.5.2.

Standard LRFD

Distribution Factor Input Method

Use Simplified Method Use Advanced Method Use Advanced Method with 1994 Guide Specs

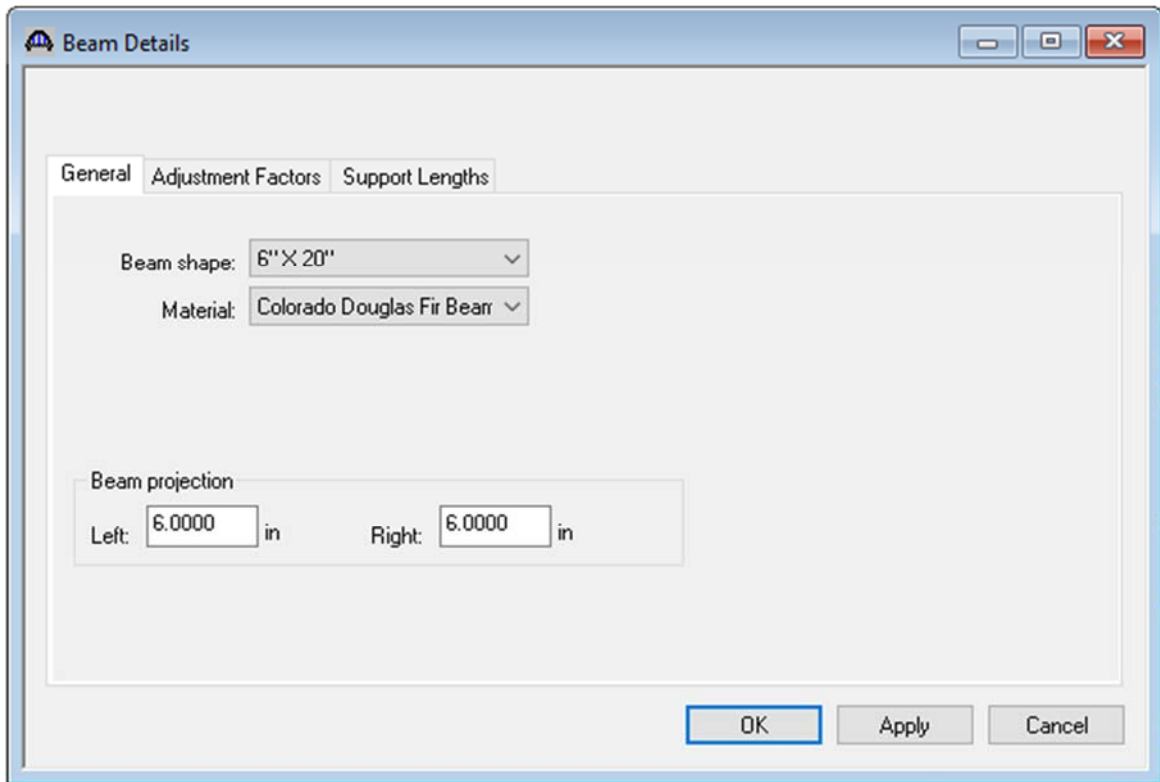
Allow distribution factors to be used to compute effects of permit loads with routine traffic

Lanes Loaded	Distribution Factor (Wheels)			
	Shear	Shear at Supports	Moment	Deflection
1 Lane	0.508	1.000	0.417	0.154
Multi-Lane	0.545	1.000	0.490	0.308

Compute from Typical Section... View Calcs

OK Apply Cancel

Open the Beam Details window by double clicking on Beam Details in the Bridge Workspace tree. The Beam Details window is shown below.



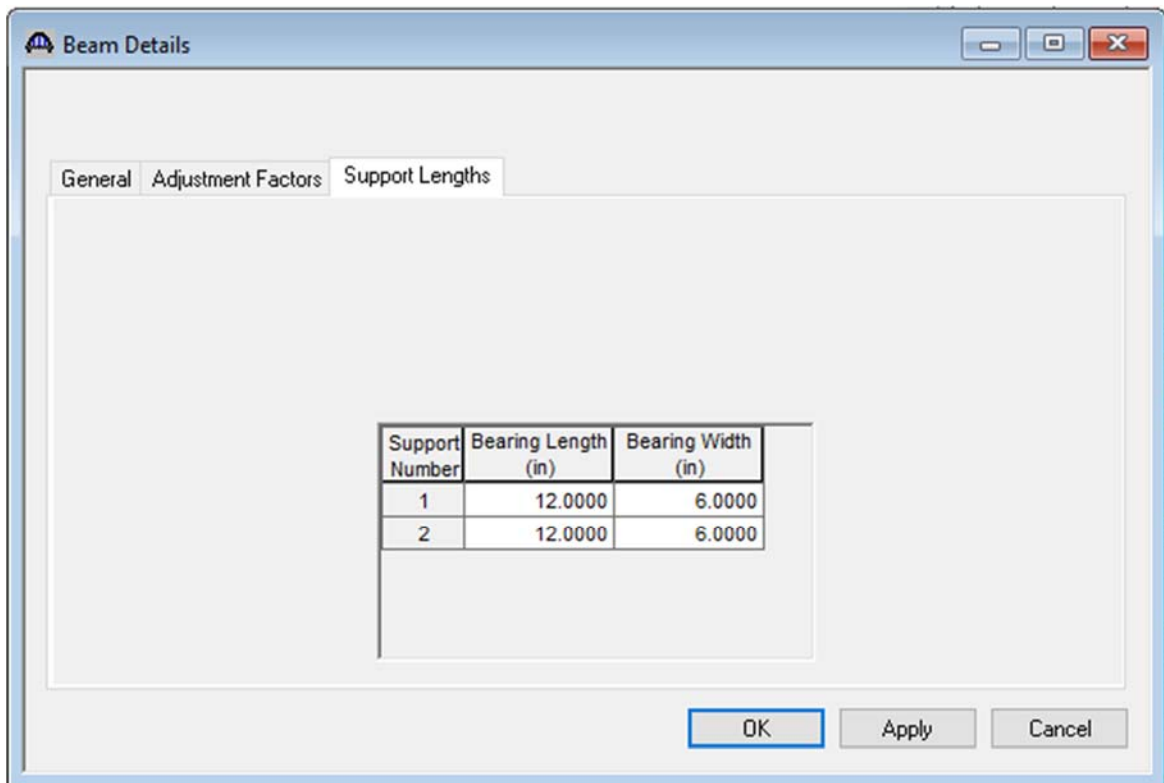
The Adjustment Factors tab of the Beam Details window allows you to enter adjustment factors to modify the tabulated design values entered on the Bridge Materials – Timber – Sawn window. The tabulated design values modified by these adjustment factors produce the design allowable stresses. In Colorado, dry moisture condition is used. Adjustment factors may be defaulted by using the BrR compute button.

The screenshot shows the 'Beam Details' window with the 'Adjustment Factors' tab selected. The window contains several input fields and dropdown menus for adjusting design values. The 'Compute' button is highlighted in blue.

Parameter	Value
Moisture condition for shear/flexure:	Dry
Moisture condition for bearing:	Dry
Moisture condition for modulus:	Dry
Shear factor:	1.000
Wet service (flexure):	1.000
Wet service (shear):	1.000
Wet service (bearing):	1.00
Wet service (modulus):	1.000
Size factor (flexure):	0.945
Flat use factor:	1.00
Repetitive use factor:	1.00
Load duration factor:	1.150

Buttons: OK, Apply, Cancel, Compute

Enter the following data for the Support Lengths tab. Click OK to save to memory and close the window.

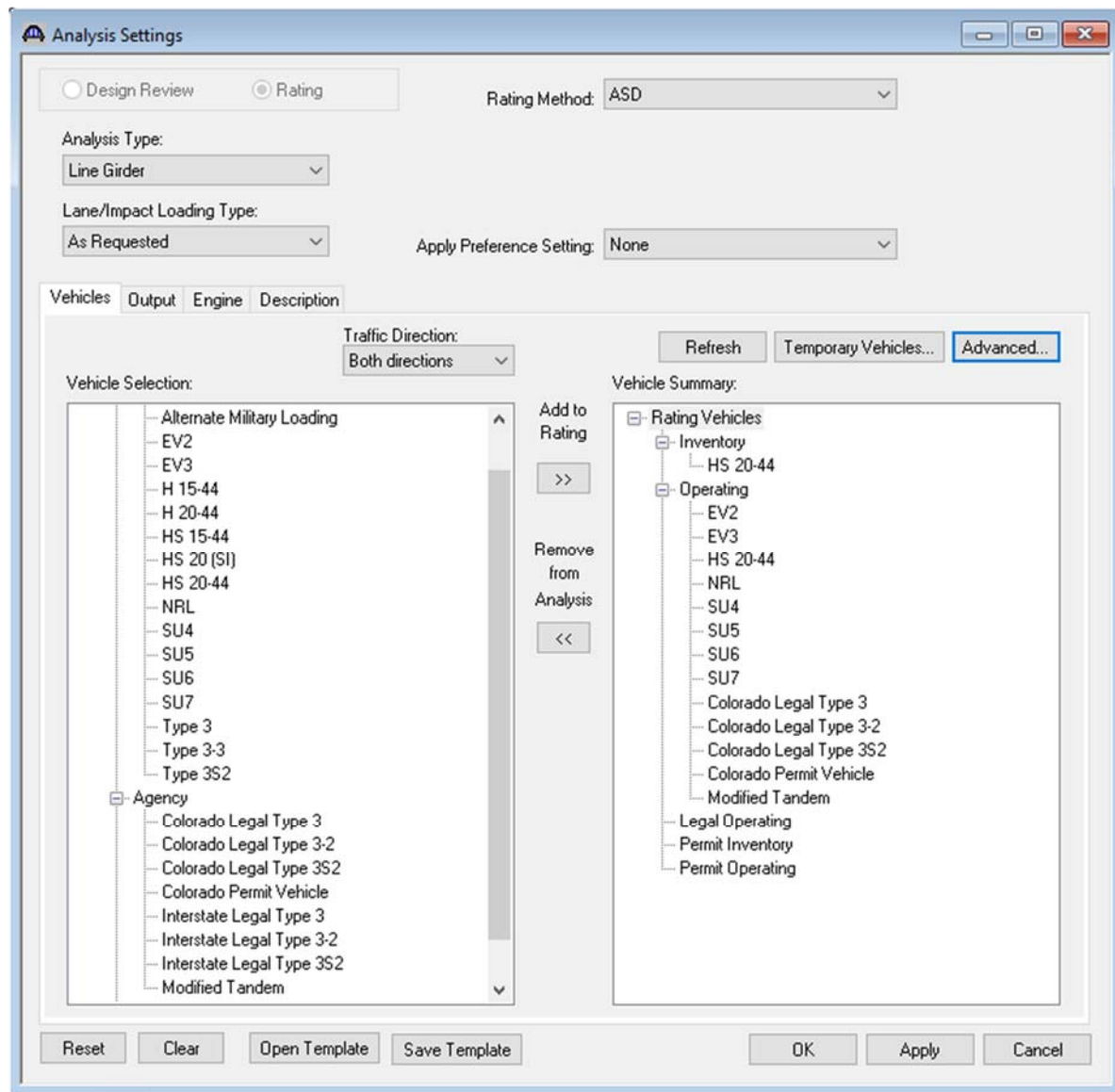


The screenshot shows a software dialog box titled "Beam Details" with three tabs: "General", "Adjustment Factors", and "Support Lengths". The "Support Lengths" tab is active and contains a table with the following data:

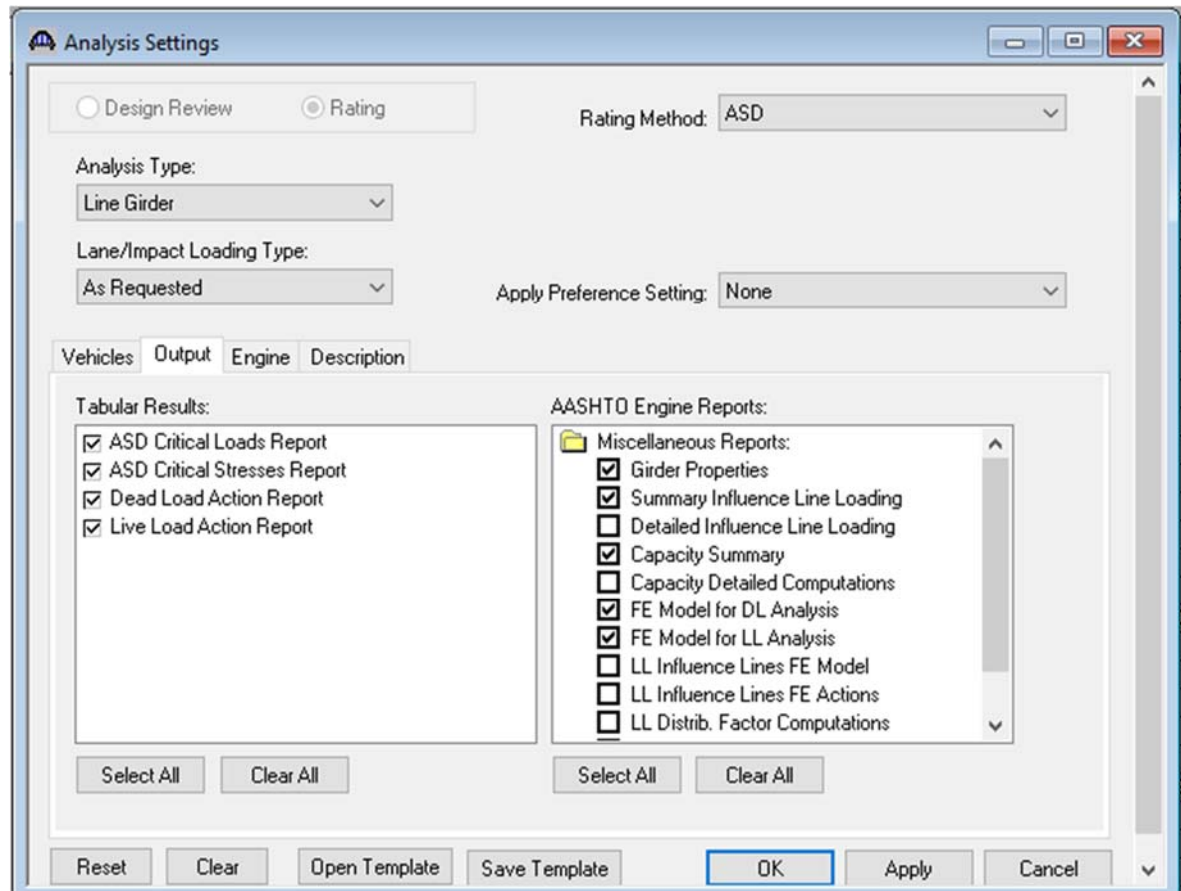
Support Number	Bearing Length (in)	Bearing Width (in)
1	12.0000	6.0000
2	12.0000	6.0000

At the bottom right of the dialog box, there are three buttons: "OK", "Apply", and "Cancel". The "OK" button is highlighted with a blue border.

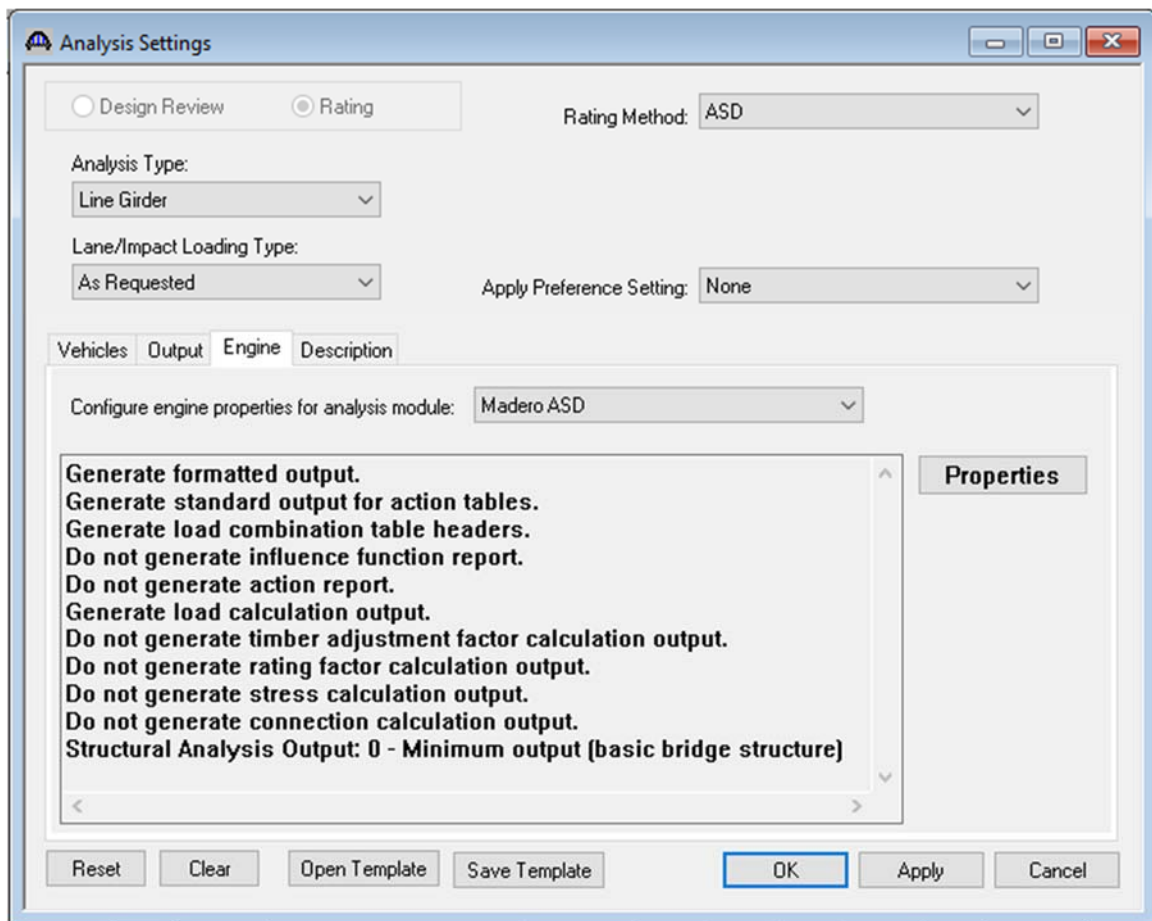
To perform a rating analysis, select the Bridge Analysis Settings button on the toolbar to open the window shown below. Select ASD as the Rating Method, select HS 20-44 vehicle or other vehicles to be used in the rating and click OK.



Select the output tab of the Analysis Settings window. Check specific boxes next to the desired output report and click the Engine tab.



Select the analysis engine and click the Properties tab.



Select the desired Output Options and click OK.

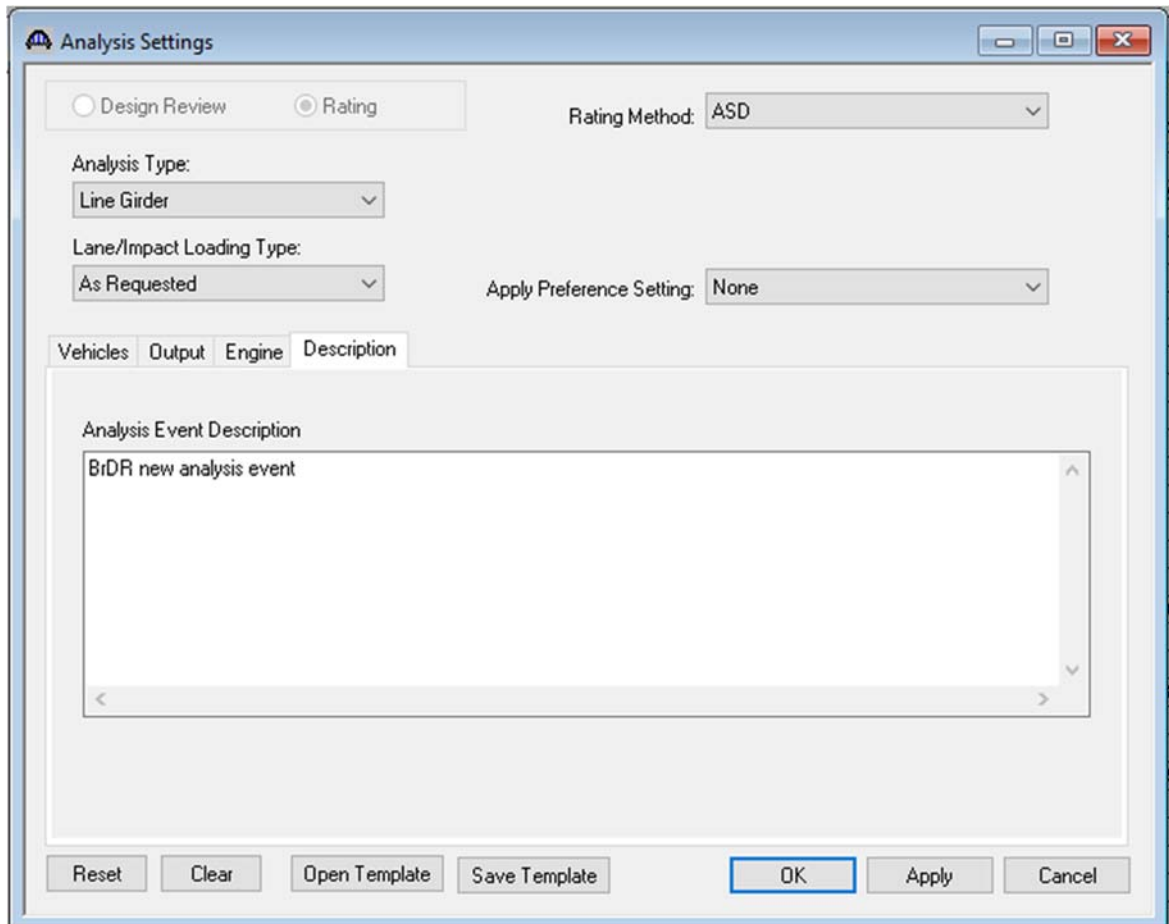
The screenshot shows a dialog box titled "Madero ASD - Analysis Event Properties" with a close button (X) in the top right corner. The dialog has a tab labeled "Output Options". Inside the dialog, there are three main sections: "Format:", "Calculations:", and "Reports:".

- Format:**
 - Formatted Output
 - Abbreviated Action Tables
 - Load Combination Table Headers
- Calculations:**
 - Load Calculations
 - Timber Adjustment Factor Calculations
 - Rating Factor Calculations
 - Stress Calculations
 - Connection Calculations
- Reports:**
 - Influence Function Report
 - Action Report

At the bottom of the dialog, there is a label "Structural Analysis Output" followed by a dropdown menu currently showing "0 - Minimum output (basic bridge structure)".

On the right side of the dialog, there are two buttons: "OK" (highlighted with a blue border) and "Cancel".

Click the Description tab, provide a general narrative description of the analysis event and click OK.



The screenshot shows the "Analysis Settings" dialog box with the "Description" tab selected. The "Rating" radio button is selected, and the "Rating Method" is set to "ASD". The "Analysis Type" is "Line Girder", and the "Lane/Impact Loading Type" is "As Requested". The "Apply Preference Setting" is "None". The "Analysis Event Description" text area contains the text "BrDR new analysis event". The "OK" button is highlighted.

Analysis Settings

Design Review Rating

Rating Method: ASD

Analysis Type: Line Girder

Lane/Impact Loading Type: As Requested

Apply Preference Setting: None

Vehicles Output Engine **Description**

Analysis Event Description

BrDR new analysis event

Reset Clear Open Template Save Template OK Apply Cancel

13.6 CDOT BRIDGE TIMBER RATING PROGRAM DESCRIPTION

The TIMBER computer program performs the complete analysis and rating of simple span timber bridges. The program was developed in accordance with the AASHTO Standard Specifications and the AASHTO Manual for Condition Evaluation of Bridges.

The program will not rate flooring placed longitudinally, splined or doweled flooring, multiple layered decks, nor nontimber decks. In accordance with subsection 13.2, the program does not modify the user input values for allowable stresses.

The program does not consider dead loads other than those caused by the stringers, deck, and overlay. In the case where other dead loads are present that would substantially affect the rating, they shall be accounted for during the analysis.

In the TIMBER program, the nail laminated and plank timber decks shall be rated for non-continuous between stringers while the BrR program rates for continuous. Conventionally, the TIMBER program shall be used for conservative.

The asphalt overlay depth is used to compute the dead load, using the asphalt unit weight of 146.67 pcf. When the timber bridge has gravel overlay (unit weight = 120 pcf) the depth entered should be the equivalent depth of asphalt to gravel. This is done by taking the actual depth of gravel, dividing it by 1.2, and entering the result into the required depth column. The actual depth of gravel shall be shown on the Rating Summary Sheet.

The following information appears as output from the program.

13.6.1 Stringer (For Information Only)

The Bridge Rating Program shall not use for stringer rating. The BrR program shall be used for timber stringer ratings.

- A) Total dead load moment and shear for the stringer being rated.
- B) Live load moment and shear due to HS 20 truck.
- C) Stringer rating for bending and shear for Inventory and Operating stress levels.
- D) Live load moment and shear due to all three Colorado posting trucks.
- E) Posting ratings for bending and shear for all three Colorado posting trucks. If all posting rating values are greater than the respective posting truck weights, and the operating rating is greater than or equal to 36 tons, then the posting ratings are not printed.
- F) The Overload Color Code Rating for the stringer being rated is based on either shear or bending, depending on which controls.

13.6.2 Decking

- A) Deck rating for nail laminated and plank floors at Inventory and Operating stress levels. Only design vehicle deck load ratings shall be reported in the RSS.
- B) Posting ratings for all three Colorado posting trucks do not need to report in the RSS.
- C) The Overload Color Code Rating is not a function of the deck rating.

13.7 TIMBER BRIDGE DECK RATING EXAMPLES

Timber Rating Program Input:

Description Data				
Structure Number:	LA-27-A	Rater:	AI	
Batch ID:	1030	No. of Lanes:	2	
Hwy. Number:	385			
Deadload				
Asphalt Overlay (in):	7			
Structure Data				
Deck Type:	Laminated	Deck Thickness (in):	6	
Plank Width (in):				
Stringer Width (in):	6	Stringer Depth (in):	20	
Stringer Spacing (ft):	2.083	Effective Span Length (ft):	23	
Material Properties				
Inv. Bending Stress (PSI):	1600	Inv. Shear Stress (PSI):	113	
OK		Cancel	Apply	Write to File

Timber Rating Program Output:

Batch: 1030 Timber Bridge Rating Date: 6/13/2019
 Rater: AI Structure Number: A-27-A State Highway: 385

Number of Lanes: 2
 Floor Type: Laminated
 Effective Span Length: 23.000 ft.
 Stringer Spacing: 2.083 ft.
 Stringer Width: 6.000 in.
 Stringer Depth: 20.00 in.
 Floor Thickness: 6.00 in.
 Bituminous Overlay Thickness: 7.00 in.
 Allow. Stress in Bending: 1600.0 PSI
 Allow. Shear Stress: 113.0 PSI

HS-20 Truck (Gross Wt. 36 Tons)

Deadload Moment: 17.77 KIP-ft.
 Liveload Moment: 45.09 KIP-ft.
 Deadload Shear: 1.75 KIPS
 Liveload Shear: 8.34 KIPS

	Inventory Rating	Operating Rating
Deck Rating	134.5 Tons	179.1 Tons
Stringer		
Bending	28.4 Tons	42.4 Tons
Shear	31.5 Tons	44.3 Tons
Moment Capacity	53.33 KIP-ft	70.93 KIP-ft
Shear Capacity	9.04 KIPS	12.02 KIPS

```

+ + + Overload Information + + +
+
+ Color Code = White +
+
+ 1-Axle (KIPS) = 44.388 +
+ 2-Axles (4-0) = 53.245 +
+ 3-Axles (4-0) = 57.788 +
+ 4-Axles (4-0) = 67.282 +
+
+ These Loads Assume 1-Lane +
+ Distribution Factor +
+++++
```

COLORADO DEPARTMENT OF TRANSPORTATION		Structure #	A-27-A
TIMBER RATING SUMMARY		State Highway #	385
Rated using:		Batch I.D.	1030
Asphalt thickness: <u>7</u> in.		Structure Type	TTS
<input checked="" type="checkbox"/> Colorado legal loads	<input type="checkbox"/> Multi-lane for Legal & Permit Vehicles	Parallel Structure #	NONE
<input type="checkbox"/> Interstate legal loads	<input checked="" type="checkbox"/> Single lane for Legal & Permit Vehicles		

Structural Member	No Split Int Girder	Split Int Girder	Repaired Int Girder	Deck	
Tons					
Inventory	27.6	21.8	21.8	134.5	
Operating	40.5	32.6	39.3	179.1	

Type 3 truck	35.3	27.9	33.6		
Type 3S2 truck	54.4	43.0	51.9		
Type 3-2 truck	56.1	44.4	53.5		
Type SU4 truck (27T)		28.9	34.8		
Type SU5 truck (31T)		31.0	37.4		
Type SU6 truck (35T)		34.8	40.1		
Type SU7 truck (39T)		38.8	44.7		
NRL (40T)	46.3	39.1	46.2		
EV2 (28.75T)	36.2	28.6	34.5		
EV3 (43T)	36.8	29.1	35.1		
Permit Truck (96T)	84.9	70.9	84.7		
Modified Tandem (50T)	50.0	39.5	47.6		



<p>Comments:</p> <p>Allowable Bending stress=1600 psi Allowable Split Shear stress =85 psi Allowable Repaired Split Shear stress =97.74 psi Color Code:YELLOW Based on modified tandem for Repaired stringers Re-rated per request from the Inspection Team. More than 25% of the girders are splits and/or repaired.</p> <p>Rated with BrR v6.8.2 for Timber girders</p>		<p>RE Seal</p>
Rated by: (Print name and sign)	Date:	Checked by: (Print name and sign)

13.8 GUIDELINES FOR SISTER BEAM RATING

The term “Sister Beam” is used when a new steel beam/section or a new timber stringer is added to an existing timber structure, and placed adjacent to or side-by-side an existing damaged or deteriorated timber stringer, to add structural capacity or carry the existing stringer load.

Adding a Sister-Beam to an existing structure is a major rehabilitation and should be designed and rated using LRFD and LRFR methods respectively.

AASHTOWare BrR software should be used for the rating.

The existing timber stringers shall be rated using ASD method with single lane loaded for Legal Load vehicles and Colorado Permit vehicles. The new sister-beam/s shall be rated using LRFR method with single lane loaded for Legal Load vehicles and Colorado Permit vehicles. The Live Load Impact shall be considered for the sister-beam, but not for the timber stringer. The entire structure should be rated in both ASD and LRFR for the existing stringers and new sister-beam/s respectively.

Substructure does not need to be rated except as requested by the Bridge Inspection Engineer.

The Rating Summary sheet shall show both the existing stringers and the new sister-beam ratings and denote the controlling one.

Major and Minor timber structures with sister-beam/s should be rated the in same manner in accordance with this section.

Damaged / Deteriorated stringer covers stringers that have been evaluated as broken, checked, cracked, split, or decayed stringer. Existing timber stringers condition evaluation should follow Subsection 13-3 and 13-4.

The rater and checker shall complete the rating documentation as described in Section 1 of the Bridge Rating Manual. Any variation from the original design assumptions shall be added to the Rating Summary Sheet as applicable. The rating package requirements shall be per Section 1.13 and Section 1.14 of the Bridge Rating Manual and as amended herein.

The Designer should review the superstructure rating to make sure it meets the design’s load path and assumptions.

13.8.1 LIVE LOAD DISTRIBUTION

Matching the existing stringers deflection, stiffens, and load path should be considered when adding a structural support or a sister beam. To maintain the existing structure behavior and load path, the new sister beam is usually designed to match the existing stringers deflection, stiffness, depth, etc.

The load sharing between the new sister-beam and the damaged / deteriorated existing stringer can be calculated in different way. Different load sharing calculation could result

in different LLDF between the new and other existing stringers. The designer should be consulted in verifying the intent of the design, the LLDF calculation methodology, and the final load distribution factors.

Based on the provided load sharing example in this section and other load sharing calculations, in most cases, the damaged/deteriorated stringer carries about 10% to 20% of the load while the new sister-beam carries the rest. On the long term, the damaged/deteriorated stringer might continue to lose its capacity and the new sister-beam may be required to carry all the dead and live load. To minimize repetitive ratings, the new rating should ignore any capacity of the damaged/deteriorated stringer and apply all the load to the new beam, unless otherwise approved in advance by CDOT Staff Bridge Rating Engineer.

For consistency among ratings and for simplification purposes, distribution factors should be calculated based on average girder spacing since the spacing can differ. (In reality, the spacing might have not changed much considering the damaged/deteriorated timber stringer still exist).

The existing sound timber stringers should be the controlling stringers in the rating. The design should be re-evaluated if otherwise.

Service-II Limit State is intended to control the yielding of steel and slip-critical connections. It is considered to be midway between Service-I and Strength-I Limit States. Service-II usually does not control non-composite, non-compact steel sections. Accordingly, Service-II rating maybe ignored when rating steel sister-beam structures, (Reference AASHTO LRFD 9th edition and MBE 3 Edition).

Below is an example calculation of live load sharing between a split timber stringer and a new steel sister-beam. The rater and designer should convene to insure consistency between the rating and the design intent.

Sharing Live Load

The spacing between the sister beam and the split timber stringer is close (side by side). Therefore, the deflection of sister beam shall be the same as the split timber stringer.

Sister beam:

$$Deflection_S = \frac{P_S \cdot L^3}{48 \cdot E_S \cdot I_S}$$

Split timber:

$$Deflection_T = \frac{P_T \cdot L^3}{48 \cdot E_T \cdot I_T}$$

$$Deflection_S = Deflection_T$$

$P_S + P_T = 100\%$ of wheels load. It is shared between split timber stringer & sister beam.

$$\frac{P_S \cdot L^3}{48 \cdot E_S \cdot I_S} = \frac{P_T \cdot L^3}{48 \cdot E_T \cdot I_T} \quad \text{or} \quad \frac{P_S}{E_S \cdot I_S} = \frac{P_T}{E_T \cdot I_T}$$

Timber stringer: $h_T := 20 \cdot \text{in}$ $b_T := 6 \cdot \text{in}$ Sister beam: HSS 12 x 8 x 5/16

$$E_S := 29000 \cdot \text{ksi}$$

$$E_T := 1600 \cdot \text{ksi}$$

$$I_S := 224 \cdot \text{in}^4 \quad I_T := \left(b_T \cdot \left(\frac{h_T}{2} \right)^3 \right) \quad I_T = 500 \text{ in}^4 \quad (\text{Worst case when the split is at mid-high})$$

$$P_S := 100\% \cdot \frac{(E_S \cdot I_S)}{(E_S \cdot I_S + E_T \cdot I_T)} \quad P_S = 0.89$$

$$P_T := 100\% - P_S \quad P_T = 0.11$$

The steel sister beams shall be rated with the LRFR method. Use AASHTO Table 4.6.2.2.2a-1 to determine the moment and shear LLDF for interior steel beam with plank wood deck.

Type of Deck	Applicable Cross-Section from Table 4.6.2.2.1-1	One Design Lane Loaded	Two or More Design Lanes Loaded	Range of Applicability
Plank	a, 1	S/6.7	S/7.5	$S \leq 5.0$

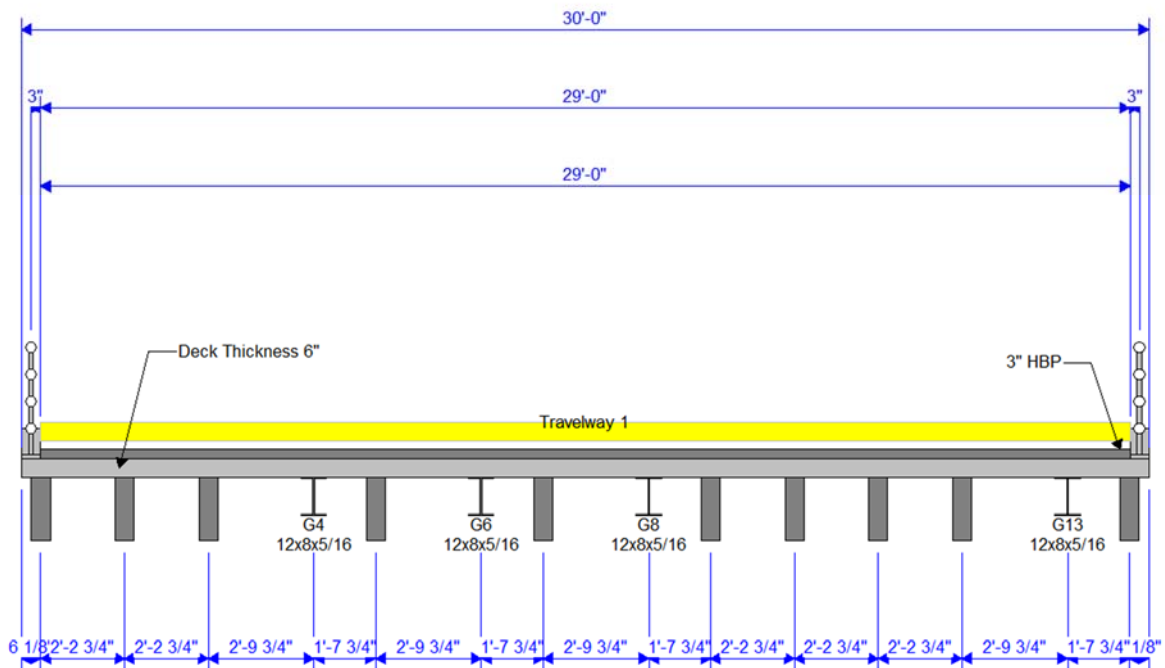
$$S := 2.229167 \text{ ft}$$

$$\text{Single lane: } LLDF_{SL} := \frac{S}{6.7} \cdot P_S \quad LLDF_{SL} = 0.296 \quad (\text{Wheels})$$

$$\text{Multi lane: } LLDF_{ML} := \frac{S}{7.5} \cdot P_S \quad LLDF_{ML} = 0.265 \quad (\text{Wheels})$$

13.9 SISTER BEAM RATING EXAMPLE, STRUCTURE X-XX-X.

Structure X-XX-X AASHTOWare BrR Rating is presented below as an example. This structure is a 1-Span 23'-0" c-c timber stringer with steel sister beam for Girder number 4, 6, 8, and 13. The structure is 30'-0" out-to-out with original stringer spacing of 2'-2 3/4" c-c. The existing timber stringers are 6" wide x 20" deep Colorado Douglas Fir. The new Sister beam is 12x8x5/16 HSS steel section placed adjacent (side-by-side) the existing damaged or deteriorated stringer with spacing of 7" c-c. The damaged/deteriorated timber stringers are not modeled since it is assumed that the new sister-beam is carrying 100% of the load. Distribution factors should be calculated based on average girder spacing since the spacing can differ. The Live Load Impact shall be considered for the sister-beam, but not for the timber stringer. See Section 13.5 Example for more information



Structure X-XX-X Typical Section

AASHTOWARE BrR (VERSION 7.2) INPUT

From the bridge explorer, create a new bridge and complete the bridge name and information tabulation.

Bridge ID: NBI structure ID (8):

Template Superstructures
 Bridge completely defined Culverts
 Substructures

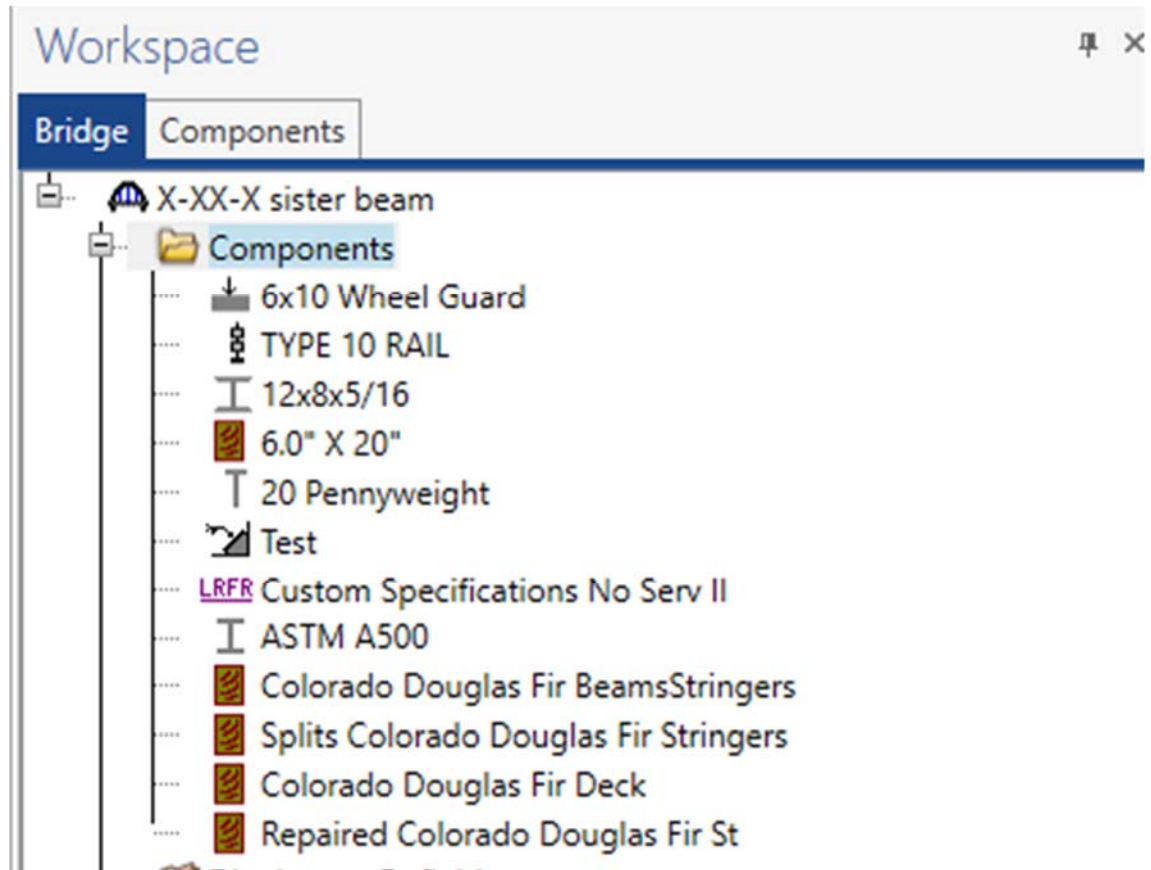
Description	Description (cont'd)	Alternatives	Global reference point	Traffic	Custom agency fields
Name:	<input type="text" value="-1"/>			Year built:	<input type="text" value="1938"/>
Description:	<input type="text" value="X-XX-X rated for present timber girders and hss sister beams. Note: Service II for legal and permit loads have been ignored on the sister beam due to a design that considers the beam to go fully plastic"/>				
Location:	<input type="text" value="SIA Item 9"/>			Length:	<input type="text" value="23.00"/> ft
Facility carried (7):	<input type="text" value="SIA item 7"/>			Route number:	<input type="text" value="00"/>
Feat. intersected (6):	<input type="text" value="SIA item 6"/>			Mi. post:	<input type="text" value="0.00"/>
Default units:	<input type="text" value="US Customary"/>				

BrR BrD BrM

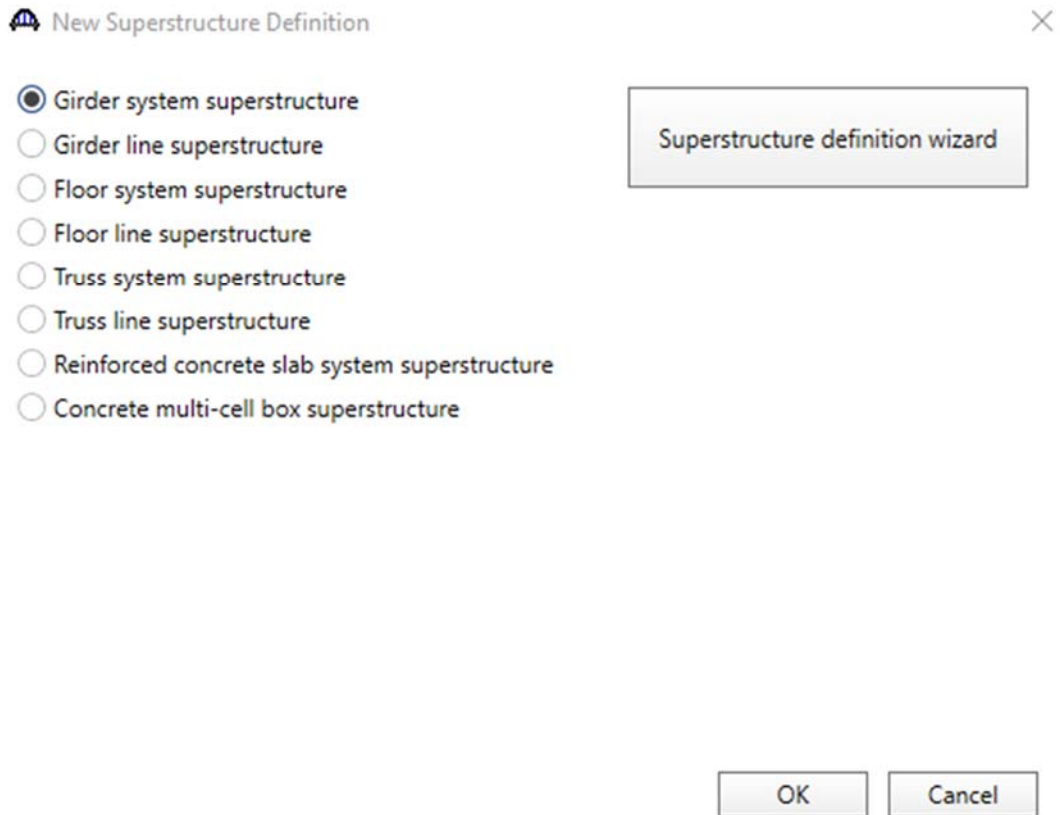
The Description should include CDOT/the Consultant company's name, the rater and checker initials, and date of completion.

The fields under the "Global reference point" and "Traffic" tabs should be completed matching the latest structure inspection and appraisal (SIA) report information.

The Components folder contains bridge components that are applicable to the entire bridge like appurtenances, beam shapes, specifications, and materials properties, see capture below:



A Girder System superstructure is selected to create a new Superstructure Definition.



Complete the new Girder System Superstructure Definition information:

Two superstructure definitions should be created, one for the ASD Timber stringer rating, and the other for the LRFD Steel beam rating. The information below is shown for the steel beam rating only.

Girder System Superstructure Definition

Definition Analysis Specs Engine

Name: Steel System w/ Timber Girders

Description: This girder system applies only to the steel sister beams adjacent to some of the timber stringers. Since the assumption is the steel stringer takes 100% of the load from an adjacent split stringer, the LLDf's have been recalculated (see spreadsheet titled "Sister Beam Rating") by multiplying by a ratio of steel stiffness to timber stiffness. Note: this system is rated using LRFR

Default units: US Customary

Number of spans: 1

Number of girders: 20

Enter span lengths along the reference line:

Span	Length (ft)
1	23.00

Modeling

Multi-girder system MCB

With frame structure simplified definition

Deck type: Timber Deck

For PS/PT only

Average humidity: %

Member alt. types

Steel

P/S

R/C

Timber

P/T

Horizontal curvature along reference line

Horizontal curvature

Superstructure alignment

Curved

Tangent, curved, tangent

Tangent, curved

Curved, tangent

Distance from PC to first support line: ft

Start tangent length: ft

Radius: ft

Direction: Left

End tangent length: ft

Distance from last support line to PT: ft

Design speed: mph

Superelevation: %

OK Apply Cancel

Complete the Load Case Description:

Load Case Description
— □ ×

Load case name	Description	Stage	Type	Time* (days)
▶ HBP		Non-composite (Stage 1) ▾	D,DW ▾	
Rail		Non-composite (Stage 1) ▾	D,DC ▾	

*Prestressed members only Add default load case descriptions

New Duplicate Delete

OK Apply Cancel

Complete Structure Framing Plan Details:

Number of spans = Number of girders =

Layout Diaphragms Lateral Bracing Ranges

Girder Spacing Orientation

Perpendicular to girder

Along support

Support	Skew (Degrees)
1	0.0000
2	0.0000

Girder Bay	Girder Spacing (ft)	
	Start of Girder	End of Girder
1	2.23	2.23
2	2.23	2.23
3	2.81	2.81
4	1.65	1.65
5	2.81	2.81
6	1.65	1.65
7	2.81	2.81
8	1.65	1.65
9	2.23	2.23
10	2.23	2.23
11	2.23	2.23
12	2.81	2.81
13	1.65	1.65

Complete the Deck folder information:

Deck

Description Factors Engine

Default rating method: ASD

Analysis module: ASD: Madero ASD

Deck rating parameters: Deck continuous over more than 2 spans

Timber deck type: Nail-Laminated Deck

Timber material: Colorado Douglas Fir B

Total deck thickness: 6.0000 in Nominal thick: 3.0000 in

Lamination thickness: 3.0000 in Nominal width: 6.0000 in

Deck LL distribution width: 21.0000 in

Nail: 20 Pennyweight

OK Apply Cancel

Complete Structure Typical Section information:

Structure Typical Section

Deck Parapet Railing Generic Lane position Striped lanes Wearing surface


Superstructure definition reference line is the bridge deck.

	Start	End
Distance from left edge of deck to superstructure definition reference line:	<input type="text" value="15.00"/> ft	<input type="text" value="15.00"/> ft
Distance from right edge of deck to superstructure definition reference line:	<input type="text" value="15.00"/> ft	<input type="text" value="15.00"/> ft
Left overhang:	<input type="text" value="0.51"/> ft	<input type="text" value="0.51"/> ft
Computed right overhang:	<input type="text" value="0.51"/> ft	<input type="text" value="0.51"/> ft

OK Apply Cancel

Complete each girder Supports information:

Supports



General Elastic 3D General 3D Elastic

Support number	Support type	Translation constraints		Rotation constraints
		X	Y	Z
1	Pinned	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>
2	Roller	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>

OK Apply Cancel

Complete Girders Default Material:

 Default Materials — □ ×

Member alternative name:

Deck timber: ▼
Beam timber: ▼
Nails: ▼

Complete the Beam Details information under each girder:

For Existing Timber Stringers:

Beam Details

General Adjustment factors Support lengths

Beam shape: 6.0" X 20"

Material: Splits Colorado Dougla

Beam projection

Left: 12.0000 in

Right: 12.0000 in

OK Apply Cancel

For New Steel Sister-Beams:

Member Alternative Description

Member alternative: Rolled shape--1

Description Specs Factors Engine Import Control options

Description:

Material type: Steel

Girder type: Rolled

Modeling type: Multi Girder System

Default units: US Customary

Girder property input method

Schedule based

Cross-section based

End bearing locations

Left: 6.0000 in

Right: 6.0000 in

Self load

Load case: Engine Assigned

Additional self load: kip/ft

Additional self load: %

Default rating method: LFD

OK Apply Cancel

Complete the Live Load Distribution factors tabulation as per the design, hand calculation, or use the “Compute from typical section” button as appropriate.

Standard LRFD

Distribution Factor Input Method
 Use Simplified Method Use Advanced Method

Allow distribution factors to be used to compute effects of permit loads with routine traffic

Action: Moment ▾

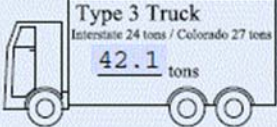
Support Number	Start Distance (ft)	Length (ft)	End Distance (ft)	Distribution Factor (Lanes)	
				1 Lane	Multi-Lane
1 ▾	0.00	23.000	23.00	0.333	0.297

Rating results are shown below for the existing sound timber stringers in ASD and the new sister-beam in LRFR.

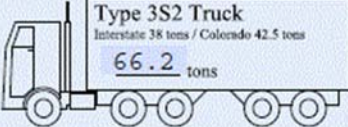
COLORADO DEPARTMENT OF TRANSPORTATION TIMBER RATING SUMMARY		Structure #	
Rated using: Asphalt thickness: <u>3</u> in. <input checked="" type="checkbox"/> Colorado legal loads <input type="checkbox"/> Multi-lane for Legal & Permit Vehicles <input type="checkbox"/> Interstate legal loads <input checked="" type="checkbox"/> Single lane for Legal & Permit Vehicles		X-XX-X	
		State Highway #	
		Batch I.D.	
		Structure Type TS	
Parallel Structure #			
Structural Member	Timber		
Tons			
Inventory	34.56		
Operating	49.17		
Type 3 truck	42.04		
Type 3S2 truck	66.17		
Type 3-2 truck	66.17		
Type SU4 truck (27T)	41.71		
Type SU5 truck (31T)	44.63		
Type SU6 truck (35T)	44.83		
Type SU7 truck (39T)	52.22		
NRL (40T)	53.91		
EV2 (28.75T)	44.15		
EV3 (43T)	43.19		
Permit Truck (96T)	98.92		
Modified Tandem (50T)	61.51		
Comments: Allowable Bending stress = 1600 psi Allowable Split Shear Stress = 113 psi Color Code: White		PE Seal	
Rated by: (Print name and sign)		Date:	Checked by: (Print name and sign)
			Date:

COLORADO DEPARTMENT OF TRANSPORTATION LOAD & RESISTANCE FACTOR RATING SUMMARY		Structure #	X-XX-X	
Rated using: Asphalt thickness: <u>3</u> in.		State Highway #		
<input checked="" type="checkbox"/> Colorado legal loads	<input type="checkbox"/> Multi-lane for Legal & Permit Vehicles	Batch I.D.		
<input type="checkbox"/> Interstate legal loads	<input checked="" type="checkbox"/> Single lane for Legal & Permit Vehicles	Structure Type	TS w Steel Sister-B ⁺	
		Parallel Structure #		


Structural Member	Steel 12x8		
Rating Factor			
Inventory	32.79		
Operating	42.51		
Tons			
Type 3 truck	42.08		
Type 3S2 truck	66.23		
Type 3-2 truck	66.23		
Type SU4 truck (27T)	41.75		
Type SU5 truck (31T)	44.67		
Type SU6 truck (35T)	52.27		
Type SU7 truck (39T)	52.27		
NRL (40T)	53.96		
Lane-Type Legal			
EV2 (28.75T)	44.19		
EV3 (43T)	43.23		
Permit Truck (96T)	124.84		
Modified Tandem (50T)	78.60		



Type 3 Truck
Interstate 24 tons / Colorado 27 tons
42.1 tons



Type 3S2 Truck
Interstate 38 tons / Colorado 42.5 tons
66.2 tons



Type 3-2 Truck
Interstate 39 tons / Colorado 42.5 tons
66.2 tons

Comments: Steel Sister Beam is HSS - 12x8x5/16. Color Code: White	PE Seal		
Rated by: (Print name and sign)	Date:	Checked by: (Print name and sign)	Date: